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DRAWINGS ATTACHED

1 200 279

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(54) A METHOD OF FORMING A STACK OF LAMINATIONS

(71) I, HANS LEUENBERGER, a Swiss Citizen, of Zürcherstrasse, 8154 Oberglatt, Switzerland, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a process for producing a stack of metal sheets or laminations, intended in particular for magnetisable armatures or the like of electrical appliances or machines. Until now, the laminations were held together by means of rivets in such stacks of laminations. The holes required for the rivets reduce the sheet metal cross-section available for the magnetic flux however, and although the rivets themselves are also magnetically conductive as a rule, the result is a reduction in the magnetic conductivity of the stack of laminations. The rivets moreover increase the eddy current losses arising in armatures employed for alternating current. Even if a stack of laminations is not intended to be employed as a magnetisable armature, riveting the laminations represents an undesirable operation. Although it is known that the laminations may be bonded to each other, especially if a paper insulating layer is additionally arranged between them, a bonding operation is relatively costly and paper insulation is rarely employed at present.

Stacks of laminations are also known, whereof the individual laminations are held together by means of concavities and convexities, the convex side of a punched convexity and concavity of one lamination engaging in the concave side of a corresponding indentation or dent in an adjacent lamination. The following procedure has been applied until now, to produce a stack of laminations of this nature: corresponding indentations were stamped in a number of laminations of the same form and size, preferably whilst simultaneously punching the lamination out of a sheet metal panel or strip. The laminations were then placed on each other, aligned and pressed together in a press, thereby effecting the engagement of the corresponding indentations of the adjacent laminations.

It is an object of the invention to simplify the production of stacks of laminations of the kind specified, and to improve the adhesion between the laminations in the stack.

The present invention consists in a method of laminating sheets comprising laying a plain sheet on an underlying sheet having at least one indentation formed therein and using said indentation as a die to form a further indentation in the plane sheet which further indentation mates with the indentation in the underlying sheet to connect the sheets together.

It is plain that the newly stamped sheet or lamination will adhere to the preceding lamination which had been employed as a female or male pattern or die, so that it is unnecessary to press the laminations against each other in a subsequent operation. It was observed moreover that the laminations adhere to each other more satisfactorily in a stack produced in this manner than in a stack produced in the manner known until now. The laminations may be punched out first, and then stamped one on another. The laminations may however be punched out and stamped on each other in a single operation.

The invention also consists in a stack of laminations or sheets produced by the process according to the invention.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows an end view of a stack of laminations;

Figure 2 shows a plan view corresponding to Figure 1;

Figure 3 illustrates a partial section taken along the line III—III of Figure 2, enlarged in scale;

Figure 4 shows a corresponding partial

section taken along the line IV—IV at right angles to the line III—III;

Figure 5 illustrates a modification of Figure 3; and

Figure 6 illustrates another modification of Figure 3.

The stack 1 of laminations illustrated in Figures 1 and 2 consists of a multiplicity of E-shaped identical laminations 2, made of easily magnetisable sheet iron, the surface of the latter being coated or enamalled in conventional manner so as to be electrically insulated. Each lamination includes indentations 3, the convex side of each indentation 3 being engaged in the concave side of the corresponding indentation 3 of the adjacent lamination or sheet, with the exception of the top sheet 2_0.

Together with a stack 1*a* of laminations held together in the same manner and drawn dash-dotted, the stack 1 of laminations illustrated forms the magnetic core of a choke coil or the like, or of a transformer. The stacks 1 and 1*a* of laminations are so compact, despite the absence of rivets which, when present normally, increase the magnetic resistance of the core and the eddy current losses, that the normal "humming" at twice the frequency of the alternating current of such magnetic cores is very largely suppressed.

The stack of laminations 1 is produced in the following manner:

The bottom sheet of lamination 2_1 is punched out initially, whereupon the indentations or dents 3 are stamped in the same by means of a female and male die. The next lamination 2_2 is punched out and then placed on the lamination 2_1, the latter then acting as a female die during the subsequent stamping of the lamination 2_2, whilst employing the same male die as for the lamination 2_1. The lamination 2_2 is then employed as a female die for the stamping of the next lamination 2_3, and so on.

It will be evident that a ready stamped lamination may also be employed as a male die or pattern for the next lamination. The individual laminations can easily be conveyed from a punching out station in which the laminations are punched out, to a stamping point at which the stamping operation occurs whilst employing the preceding lamination as a female or male die. Alternatively the punching out and stamping operations may be performed in a single operation, merely taking care to ensure that the base carrying the rising stack of laminations is drawn back after each action by the thickness of a lamination relative to the stamping tool.

Whereas the indentations 3 illustrated in Figures 1 to 4 possess an arcuate cross-section known per se in the longitudinal direction, the indentations 3*a* according to Figure 5 possess an outline in longitudinal extension consisting of straight rectilinear portions meeting each other angularly, say in the form of a symmetrical trapezium with an open base.

As established by tests, the indentations 3*a* assure even better adhesion between the laminations 2 than the indentations 3. The outline 4 of the indentations 3 or 3*a*, which is approximately rectangular in both instances, may for example have the dimensions of 5 × 2 mms with a height of approximately 1.5 mms.

Figure 6 shows that an indentation 3*b* may also be wrought in an edge 6 of the stack 2, so that this edge 6 follows the indentation 3*b*. This joint is a little less strong however than that according to Figure 5.

Stacks of laminations of the nature specified may be employed moreover for the magnetic cores of electromagnets, for the stators and rotors of motors or generators, and the like. In specific cases, it is advantageous to employ sheets or laminations of different shape and/or size within one and the same stack, for example to assure desirable magnetic shunts or for the purpose of securing the stack to other components of a machine or appliance in appropriate manner.

WHAT I CLAIM IS:—

1. A method of laminating sheets comprising laying a plain sheet on an underlying sheet having at least one indentation formed therein and using said indentation as a die to form a further indentation in the plane sheet which further indentation mates with the indentation in the underlying sheet to connect the sheets together.

2. A method as claimed in claim 1, comprising laminating a further plain sheet or sheets to said connected sheets using the indentations in said connected sheets as dies to form a mating indentation in the further sheet or sheets to form a stack of connected sheets.

3. A method as claimed in claim 1 or 2, wherein the laminations are automatically conveyed from a station at which they are punched out to a station at which the laminations are punched or stamped one upon another.

4. A method as claimed in claim 1 or 2, in which the laminations are punched out and stamped to form said indentations in a single operation, the base carrying the stack being drawn back during each operation in the course of production by the thickness of one lamination relative to the stamping tool.

5. A stack of laminated sheets produced according to the method claimed in claim 1.

6. A stack of laminated sheets as claimed

in claim 5, in which the indentations possess an elongated outline of rectilinear section.

7. A stack of laminated sheets as claimed in claim 5 or 6, in which the indentations have a profile approximately corresponding to a symmetrical trapezium with an open base.

8. A stack of laminated sheets as claimed in any of claims 5, 6 or 7, wherein the laminations are of different shape and/or size.

9. A method of forming a stack of laminations substantially as described with reference to the accompanying drawings.

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1200279 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig.1

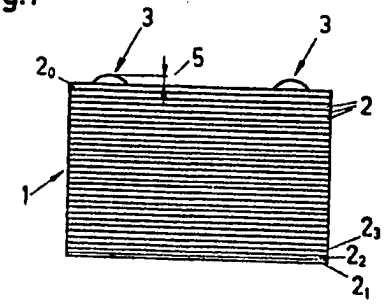

Fig. 2

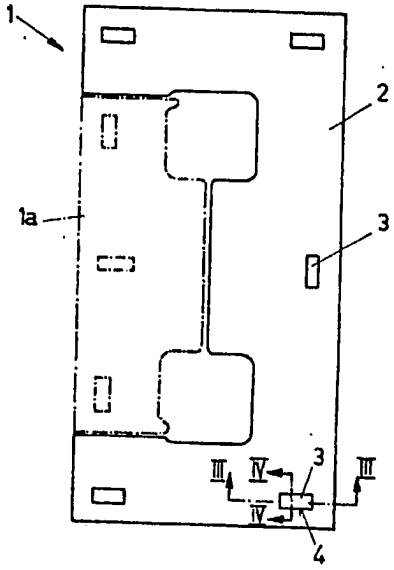

Fig. 3

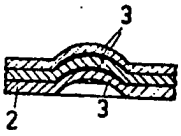

Fig. 4

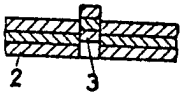

Fig. 5

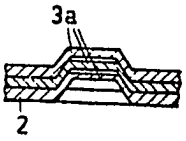

Fig. 6